



Memorandum

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 4

345 COURTLAND STREET, N.E.
ATLANTA, GEORGIA 30365

MAR 19 1996

4APT-AEB

Mr. Richard M. Everhart, QEP
Chief Engineer
Air Pollution Control District of
Jefferson County
850 Barrett Avenue, Suite 200
Louisville, Kentucky 40204

SUBJ: Proposed Opacity Monitor Relocation at Louisville Gas and
Electric (LG&E) Mill Creek Station

Dear Mr. Everhart:

This letter is in response to your September 5, 1995, request for guidance regarding an LG&E proposal to relocate the opacity monitors on Units 1-4 at Mill Creek Station. The guidance in this letter was developed in conjunction with the U.S. Environmental Protection Agency (EPA) Office of Enforcement and Compliance Assurance (OECA), and a memorandum that OECA prepared regarding the monitor relocation proposal from LG&E is enclosed.

Boilers 1 and 2 are subject to Jefferson County regulations for indirect heat exchangers, and Units 3 and 4 are subject to 40 C.F.R. Part 60, Subpart D - Standards of Performance for Fossil-Fuel Fired Steam Generators for Which Construction is Commenced After August 17, 1971. The air pollution control systems on these boilers consist of electrostatic precipitators (ESPs) followed by wet scrubbers, and LG&E is requesting that they be allowed to relocate opacity monitors on each unit from the scrubber stack to a point between the ESP and scrubber.

The company is requesting permission to relocate the opacity monitors at Mill Creek Station because of high opacity readings at the outlets of the scrubbers on these units. Based upon the results of testing conducted at the plant, the primary cause of the high opacity on these units is believed to be SO₃. Interference from water droplets in the scrubber stacks is not considered to be a major contributor to the high opacity monitor readings because the flue gas on these units is reheated after the scrubbers, and testing indicates that the water vapor content of the flue gas at the opacity monitoring locations is below saturation.

There were five questions in your letter, and the first of these was whether the opacity monitors at Mill Creek Station should be relocated. After considering the relevant issues, EPA has determined that the opacity monitors at Mill Creek Station should not be relocated. The basis for this conclusion is that opacity monitor data collected between the ESPs and scrubbers at Mill Creek Station would not be representative of the opacity read at the stack exit by a certified visible emissions (VE) observer.

EPA does not believe that a decision to prohibit the relocation of opacity monitors at Mill Creek Station is inconsistent with our previous decision to allow opacity monitoring between the ESPs and scrubbers at the LG&E Cane Run Station. The basis for the conclusion that these decisions are not inconsistent is that flue gas is not reheated at Cane Run, and water droplets are present in the exhaust stacks at this facility. 40 C.F.R. §60.13(i)(1) affords source owners and operators the opportunity to propose alternative monitoring when liquid water or other substances in the flue gas interfere with the ability to obtain accurate measurements, and the approval to relocate opacity monitors at Cane Run Station was granted under these provisions. Since there is no evidence that water droplets are present in the exhaust stacks at Mill Creek Station, approval to relocate the opacity monitors at this facility under the provisions of 40 C.F.R. §60.13(i)(1) would not be appropriate.

The second question in your letter was whether SO₂ emissions should be included in opacity monitor values. EPA believes that SO₂ emissions should be included in opacity monitor values since a certified VE reader collecting EPA Method 9 data on a stack where SO₂ is present cannot differentiate between the opacity caused by SO₂ and the opacity caused by particulate matter. Since there is no way for a certified VE observer to adjust Method 9 readings for the presence of SO₂, opacity monitor readings should not be adjusted either.

The third question in your letter was whether EPA recommends any additional testing for water droplet interference. Although EPA would be willing to consider any additional information that LG&E supplies regarding water droplet interference at Mill Creek Station, Region 4 does not have any specific recommendations for testing that should be conducted. It has already been established that the moisture content of the flue gas after the scrubbers at Mill Creek Station is below saturation, and previous testing conducted by LG&E led to the conclusion that the major contributor to high opacity at the plant is SO₂. Therefore, it is unlikely that additional testing will prove that water droplets are a cause of the high opacities observed at Mill Creek Station.

The fourth question in your letter asked for guidance regarding how the opacity monitors at Mill Creek Station could be used for compliance if they are moved. Since EPA had concluded that the opacity monitors at this facility should not be moved, guidance on determining compliance using relocated monitors is unnecessary.

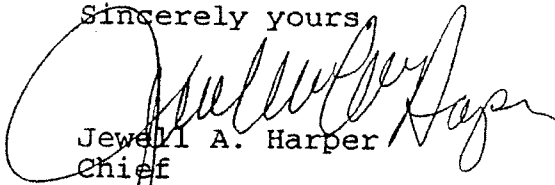
The final question in your letter asked for guidance regarding the procedures that LG&E should follow if the company decides to petition for an alternative opacity standard under the provisions in 40 C.F.R. §60.11(e)(6), (7), and (8). In response to this request, Region 4 has enclosed a copy of national guidance that EPA issued on petitions for alternative opacity limits. This guidance identifies nine items that must be addressed in such requests.

In the case of Mill Creek Station, Region 4 believes that Requirement 4 (a demonstration that a source is incapable of being operated in order to comply with the applicable opacity standard) will be a key issue. The Region believes that this requirement will be an important consideration for the units at Mill Creek Station since previous testing conducted by LG&E indicates that ammonia injection greatly improves opacity at the facility. Therefore, in order for EPA to consider granting an alternative opacity limit, LG&E would need to prove that ammonia injection is not a viable, long-term option and demonstrate that the company has investigated all other possible means of reducing opacity.

In order to assist LG&E with identifying other factors that can contribute to the production of SO₂ and cause high opacities, Region 4 is also enclosing a copy of a paper entitled "Impact of Sulfuric Acid on Plume Opacity." According to this paper, factors that can affect the production of SO₂ include furnace O₂, fly ash recirculation, coal sulfur content, and the amount of vanadium and iron in the coal combusted. If LG&E decides to pursue approval of an alternative opacity limit, Region 4 recommends that the company investigate whether adjustments with respect to any of these factors could play a role in reducing the opacity at Mill Creek Station.

If you have any questions about this response to the questions in your letter of September 5, 1995, please contact Mr. David McNeal of my staff at (404) 347-3555, voice mail extension 4158.

Sincerely yours,

A handwritten signature in black ink, appearing to read "Jewell A. Harper", is written over the typed name and title.

Jewell A. Harper
Chief

Air Enforcement Branch
Air, Pesticides and Toxics
Management Division

Enclosures



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

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OFFICE OF
ENFORCEMENT AND
COMPLIANCE ASSURANCE

MEMORANDUM

SUBJECT: Request to Relocate Opacity Monitors at the
Louisville Gas and Electric (LG&E) Mill Creek Station,
Louisville, Kentucky

FROM: *Virginia Latham for*
David N. Lyons, P.E. Chief
Energy and Transportation Branch
Manufacturing, Energy and Transportation Division

TO: Jewell A. Harper, Chief
Air Enforcement Branch
Air, Pesticides, and Toxics Management Division
Region IV

This memorandum is in response to Division Director Winston Smith's memorandum dated October 17, 1995. In the memo, Region IV requested that Environmental Protection Agency (EPA) Headquarters review Region IV's response letter to the Louisville Gas and Electric's (LG&E) request to relocate opacity monitors at Mill Creek Station, Louisville, Kentucky. I apologize for our tardy response. I understand that a response has been given verbally, and this will serve as confirmation.

In Summary, Region IV is disapproving LG&E's request to relocate their opacity monitors. The reason for the decision is that since Mill Creek Units 1-4 employ flue gas reheat, opacity monitoring interference due to water droplets is not a concern on the Units. Therefore, the opacity currently measured in the scrubber stacks on Units 1-4 should be representative of that which would be reported by a certified visible emissions reader collecting opacity data at the scrubber outlet. Since there is no assurance that the opacity between the electrostatic precipitators and scrubbers at the Mill Creek Station has any relationship to opacity at the scrubber outlet, the scrubber outlet is clearly the best opacity monitoring location for Mill Creek Units 1-4.

After reviewing the letter and the information provided by your office, we agree with the Region's position. We believe Region IV's response to LG&E is consistent with the Headquarter's policy. As for your request for other Regional Offices' positions, we have not received this type of request from other Regions recently. However, please check with the Regions and the COMPLI Bulletin Board for past determinations on this issue.

If you have any questions, please contact Chris Oh of my staff at (202) 564-7004.

IMPACT OF SULFURIC ACID
ON
PLUME OPACITY
A PERSPECTIVE

Prepared by:

William T. "Jerry" Winberry, Jr.
Engineering-Science
501 Willard Street
Durham, North Carolina
27701

September 23, 1985

1.0 Introduction

EPA Federal Reference Method 9, Visual Determination of the Opacity of Emissions from Stationary Sources, is the legal enforcement method for opacity standards for affected facilities nationwide. Many sources have also been required to install opacity monitors to document emissions on a continuous basis. Indeed, throughout many sections of the United States, continuous emission opacity monitors have been used for enforcement purposes by both State and Federal Agencies. Recent EPA legislation has stated that certain sources covered under New Source Performance Standards must install, operate, and maintain continuous emission opacity monitors and report excess emissions to the enforcement agency. Excess emissions recorded by the continuous emission opacity monitor may be used in an enforcement action. For other sources, however, enforcement agencies have relied on Federal References Method 9 for enforcement of the opacity standard.

Those facilities that have installed continuous emission opacity monitors but which are regulated by Federal Reference Method 9 may experience a discrepancy between the two measurements. The discrepancy may be because the continuous emission opacity monitor measures opacity in the stack or duct while visible emissions are observed at the stack exit in the surrounding environment. Both measurement techniques may be accurately measuring the opacity as viewed at each location; however, they may not agree with each other. The discrepancy that may develop between the two values has historically been related to "condensable particulates" at the stack exit, causing increased plume opacity and possible violation of the opacity standard. However, the in-stack continuous emission opacity monitor does not measure this because the condensable particulates form downstream from the opacity monitor location.

A lack of definitive information on the nature of condensable particulate emissions has created a degree of uncertainty in EPA's enforcement efforts. The enforcement issue is whether EPA should require that an opacity standard be met when the source is in compliance with the mass emissions limitations. The common assumption is that opacity is an indicator of the mass emissions from a source. For the sources which have physical and/or chemical transformation occurring within the duct or stack subsequent to its emission from the source, the enforcement applicability of in-stack opacity or mass emission rates of particles is limited. When the physical and chemical transformations result in the production of aerosols and/or particles either by condensation or gas phase production of secondary particles at the stack exit, the enforcement by EPA Federal Reference Method 9 is limited. This disparity causes significant problems for both the enforcement agency and the regulated facility.

2.0 Discussion

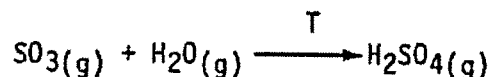
2.1 Condensable Particulates

Condensable particulate begins as gaseous or vaporous substances, then form into liquid or solid matter at lower temperatures. Chemical and physical mechanism significantly influence condensable particulate matter formation. Condensable particulate emissions originate from both inorganic and organic compounds, and can be primary or secondary particulate emissions. Primary particulate is produced directly at the process, whereas secondary particulates are produced from gases and vapors by chemical and physical conversion. Both primary and secondary particulates may originate from the same source. For example, coal-fired utilities release large quantities of primary particulate in the form of fly ash. In addition, the sulfur in the coal is oxidized to SO_2 which combines with water to form sulfuric acid (H_2SO_4), either in the duct work or in the plume. Recent studies have confirmed that condensable particulates that increase plume opacity from coal fired industrial/utilities boiler is primarily sulfates (SO_4^{2-}), in the form of sulfuric acid.

The origin of sulfate emissions, either as primary or secondary sulfates, naturally begins with the formation of SO_2 , from the combustion of fossil fuels, at the burner tip. At the burner tip, SO_2 formation occurs within the primary flame zone at rates comparable to other combustion reactions. Formation will proceed in both air-rich and fuel-rich flames at fuel-air ratios up to about 1.4 times stoichiometric. Formation of SO_2 is, therefore, unavoidable, and most of the fuel sulfur will be exhausted in this form.

As one moves away from the flame, the formation of SO_3 increases while the production of SO_2 decreases. This formation of SO_3 is a function (but not limited to) of the mixing temperature and oxygen content of the flue gas. At high temperatures, as in the flame, the amount of SO_3 is less than 0.1% of the total sulfur. As the temperature decreases away from the flame, the relative amount of SO_3 increases to 10% of the total sulfur at about 750°F. This increase is caused by the increase oxygen atom concentration away from the flame. Once the oxygen atom concentration begins to decrease, formation of SO_3 ceases and remains constant. The final level of SO_3 is found to be dependent upon such variables as O_2 content, rate of cooling, rate and location of excess air mixing, sulfur content of the fuel, chemical kinetics, surface catalytic activity and combustion temperature.

Once sulfur trioxide is formed, it will react immediately with any water vapor present in the stack gas to form sulfuric acid by the following equilibrium equation:



The amount of sulfuric acid produced is not only dependent upon the amount of water vapor present in the stack gas, but also the temperature of the stack gas. Nearly all of the SO_3 combines with the water vapor when the stack gas temperature is below the boiling point of sulfuric acid, or about 327°C (620°F).

Below 327°C, the sulfuric acid in the vapor stage will begin to condense from the flue gas and deposit on cold surfaces as liquid droplets of sulfuric acid. This temperature of condensation, called the dew point temperature, is generally between 93°C (200°F) and 149°C (300°F). The following empirical equation relates the sulfur trioxide concentration and water vapor concentration to the dew point temperature of the gas:

$$1000/T =$$

$$2.2276 - 0.02943 \ln p_{\text{H}_2\text{SO}_4} - 0.0858 \ln p_{\text{H}_2\text{SO}_4} + 0.0620 (\ln p_{\text{H}_2\text{O}}) (\ln p_{\text{H}_2\text{O}}),$$

In 1959 Muller developed a theoretical curve displaying the relationship between dew point, sulfuric acid concentration, and water vapor concentration, as illustrated in Figure 1.

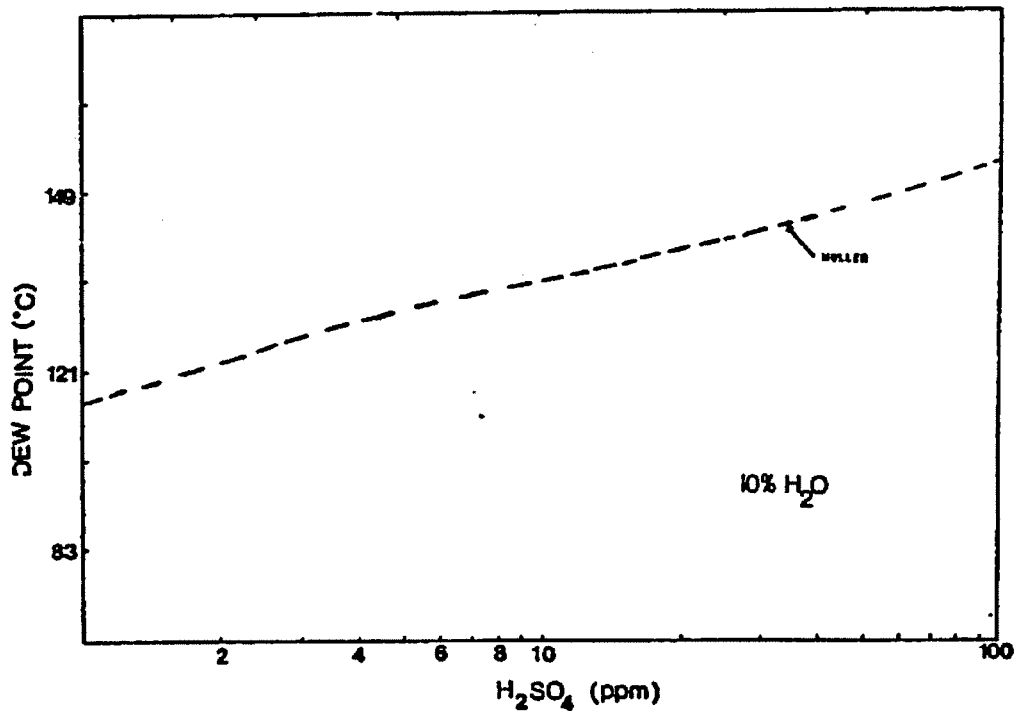


Figure 1. Theoretical Dew Point/Sulfuric Acid Curve

Information contained in Figure 1 can be used to predict the acid dew point for a 10% moisture gas stream. Other investigators who developed theoretical dew point curves include Abel, Muller, and Bancherd and Verhoff.

Goksoyr and Ross interpolated Muller's theoretical values, as indicated in Table 1.

TABLE 1
Interpolation of Muller's Theoretical Values

°C	0	1	2	3	4	5	6	7	8	9
100	0.08	0.09	0.11	0.13	0.15	0.17	0.20	0.23	0.27	0.31
110	0.36	0.42	0.49	0.57	0.66	0.76	0.88	1.02	1.17	1.35
120	1.6	1.8	2.1	2.4	2.7	3.1	3.6	4.1	4.7	5.4
130	6.1	7.0	8.0	9.1	10.3	11.7	13.4	15.2	17.2	19.5
140	22	25	28	32	36	41	46	53	59	67
150	75	84	95	107	120	135	150	170	190	210
160	235	265	295	330	370	410	460	510	570	630

For any given H_2SO_4 content, the corresponding dew point can be determined.

Since sulfuric acid has a very low vapor pressure under typical ambient conditions, nearly all of this acid in the flue gas will condense into aerosol as soon as the dew point is reached. Other non-sulfate compounds in the vapor state in the flue gas are not likely to have high enough concentrations to form significant aerosol concentrations. Therefore, the sulfuric acid concentrations in the flue gas can be reasonably well estimated by multiplying the plume excess aerosol volume by the plume dilution (the ratio of the stack to plume SO_2 concentrations) and subtracting the source fly ash and water absorbed by the acid. Because a small amount of acid produces large quantities of submicron aerosol, small quantities of acid can be detected. The most probable mechanism for the formation of sulfuric acid in the flue gas may be, but not is limited to:

- o Free radical oxidation of sulfur dioxide while the flue gas is at high temperature;
- o Catalytic oxidation of sulfur dioxide on particle surfaces due to metallic constituents of the particle;
- o Catalytic oxidation of sulfur dioxide on particle surfaces due to the carbonaceous material and adsorbed water on the particles; and
- o Catalytic oxidation of sulfur dioxide on heat exchange surfaces of the boiler furnace due to the presence of metallic compounds deposited on the surfaces.

Other possible compounds which could contribute to increased plume opacity include organic vapors due to incomplete combustion, ammonia compounds formed during the reactions of coal nitrogen, and chloride compounds formed due to high coal chloride levels.

Table 2 illustrates the effects of increase sulfuric acid production through different boiler/fuel variables.

TABLE 2
PRODUCTION OF SULFURIC ACID

Boiler Parameter	Status	Sulfuric Acid	Metal Sulfate Species
Furnace O ₂	Increase	Increase	Increase
Fly ash recirculation	Increase	Decrease	?
Sulfur in coal	Increase	Increase	?
Vanadium in coal	Increase	Increase	Increase
Iron in coal	Increase	Increase	Increase

For example, increasing furnace O₂ increases sulfuric acid and metal sulfates. Increasing vanadium or iron content in the coal has a direct effect on catalytic activity, increasing sulfuric acid and metal sulfate emissions.

Published data^a has shown that the parameters having the most effect on sulfuric acid emissions were furnace oxygen, flyash recirculation, and coal sulfur and iron content. Formation of metal sulfates (MSO₄) was primarily governed by furnace oxygen and by the iron content of the coal, i.e., with little or no iron in the coal, MSO₄ remains constant and independent of furnace O₂.

Analysis of two coals used locally in New York for combustion best illustrates the difference between sulfuric acid plumes at a local steam facility.

TABLE 3
COAL ANALYSIS

As Received Analysis	Test Coal Type	
	OHIO	MAPCO
% S	1.52%	1.07
Carbon	68.84%	70.97
Hydrogen	4.70%	5.02
Nitrogen	1.28%	1.48
Oxygen	7.18%	10.73
BTU/lb	12,379	13,224

TABLE 3 (Contd.)
COAL ANALYSIS

As Received Analysis	Test Coal Type	
	Ohio	MAPCO
<u>Ash Mineral Composition</u>		
Silicon Dioxide	54.06%	54.56%
Aluminium Oxide	26.03%	30.26%
Ferric Oxide	12.07%	8.73%
Titanium Oxide	1.52%	1.61%
Phosphorus Pentoxide	0.31%	0.33%
Calcium Oxide	2.74%	1.90%
Magnesium Oxide	0.30%	0.28%
Sodium Oxide	0.67%	0.84%
Potassium Oxide	2.44%	1.63%
Sulfur Trioxide	0.60%	0.20%

A comparison between the two coals indicate the Ohio coal to be considerably higher in % S and ferric oxide concentration. It is believed that these two constituents play a major role in the formation of sulfuric acid in the flue gas stream. Consequently, during the burning of these two coals, a sulfuric acid plume was documented. Even with the lower % sulfur present in the MAPCO coal, a sulfuric acid plume was still present at this steam facility. Consequently, it was believed that the other impurities in the coal assisted in the oxidation of SO_2 to H_2SO_4 .

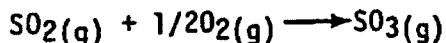
2.2 Impact of Sulfuric Acid on Plume Opacity from Coal Fired Utilities

Standards for opacity and mass emission in association with particulate matter affects both new and existing sources. Enforcement of the mass standard is determined through Federal Reference Method 5, while enforcement of the opacity standard is determined through Federal Reference Method 9. Concurrent with these requirements many sources are required to install continuous emission monitors (CEMs) for opacity to verify maintenance and satisfactory operation of control equipment to maintain emission standards. Many times, however, the two measurement methods for opacity (CEMs and Method 9) do not correlate. This may be due, in part, to condensables forming as the gas stream moves from the stack to the ambient air. The plume opacity was found to be higher than the in-stack opacity monitor. The major contributor to this increase opacity has been associated with condensing sulfuric acid. A physical transformation occurs as the gas stream moves from the burner area to the atmosphere. If the gas stream is cooled along this path, below its dew point, then condensation occurs. Additionally, as the gas stream exits the stack, the ambient air dilutes and cools the stack gas further, condensed sulfuric acid droplets form, increasing plume opacity.

These separate phenomenas have been documented to cause higher plume opacities than the in-stack opacity monitors. They are:

- o Condensation of acids (H_2SO_4 , HNO_3 , Organic, etc.);
- o Absorption of water on hygroscopic materials; and
- o Homogeneous/Heterogeneous phase reaction in the plume.

Homogeneous reactions are those in which all reactants (including catalysts) are in the same phase (i. e. gas, liquid, solid). Heterogeneous reactions involve more than one phase. In the gas phase, the production and subsequent reaction of sulfuric acid (H_2SO_4) in the plume involves the oxidation of SO_2 to SO_3 , hydration of SO_3 , condensation of the resulting acid, and reaction with particulates matter. This can be demonstrated by the following reaction:



As the gas stream exits the stack, equilibrium favors the formation of SO_3 . Once formed, the SO_3 will form an aerosol almost immediately upon contact with moist air. As illustrated in Figure 2, temperature existing in the gas stream and in the plume favors essentially all the SO_3 converted to H_2SO_4 under equilibrium conditions.

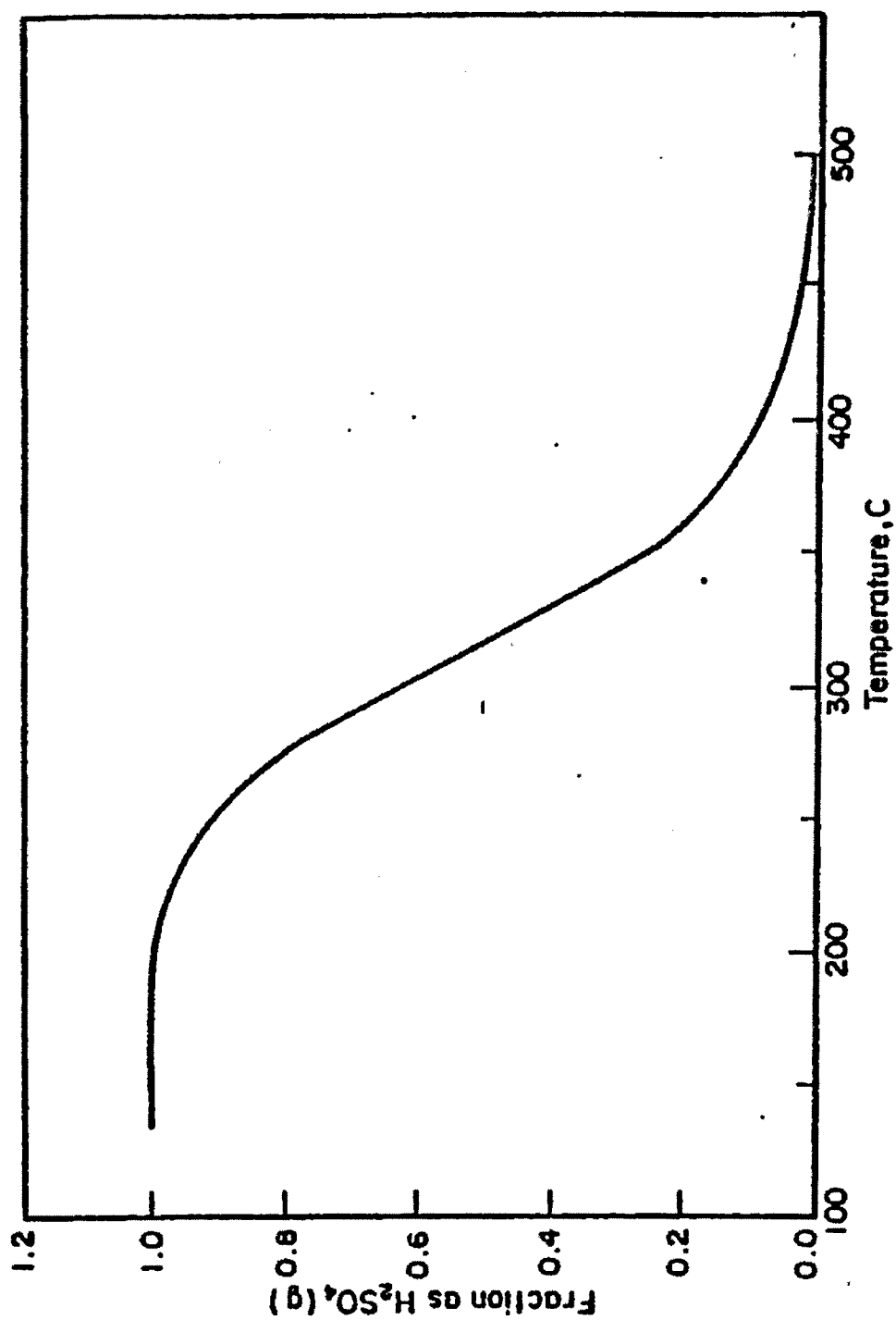
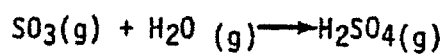


Figure 2. Equilibrium Conversion



Rate relations to determine rate of heterogeneous condensation and growth of particles for low super-saturation acid gas streams has been defined by Friedlander as:

$$N = 2\pi D d_p \left(\frac{P - P^*}{kT_p} \right) \cdot \frac{(1 + Kn) - S}{(1 + 1.71 Kn + 1.333 Kn^2)}$$

where: D = diffusivity of H_2SO_4 , cm^2/sec ;
 Kn = Knudsen Number for particle size ($d_p = 2 \lambda/dp$)
 λ = mean-free path of molecules, cm ;
 p = partial pressure of H_2SO_4 in the gas phase, $dyne/cm^2$;
 k = Boltzmann's constant;
 P^* = equilibrium vapor pressure of H_2SO_4 , $dyne/cm^2$; and
 $S = P/P^*$

After reaching high supersaturation, due to inadequate rate of condensation by the heterogeneous mechanism, the vapor molecules may self-nucleate and produce a larger number of particles of critical size. This mechanism provides a larger surface area for condensation to proceed by the heterogeneous mechanism. The size of nucleating particles formed is given by the Kelvin-Gibbs equation.

$$d_p^* = \frac{4 \sigma v_m}{kT \ln(S)}$$

where: σ = surface tension of condensed phase, $dyne/cm$;
 v_m = molecular volume, cm^3 ; and
 S = supersaturation ratio = P/P^*

The rate of generating droplets of this critical size is once again given by Friedlander.

Using the above equations, Damle and Enson determined plume opacity as a function of plume travel, particle size distributions and H_2SO_4 concentrations utilizing a Tandy TRS-80 microcomputer programmed in Fortran. The objective was to compare theoretical predicted opacities from Model parameters (sulfuric acid concentration, particle size etc.) as compared to documented field studies. Table 4 reflects the results of three(3) case studies comparing field data of plume characteristics to model parameters.

TABLE 4
COMPARISON OF THE MODEL WITH SOME FIELD OBSERVATIONS

Case #	Field Observation Available Data	Observed Opacities	Model Parameters	Model Observation Predicted Opacities
1	Sulfuric acid conc.; 8-11 ppm Typical outlet ESP size distribution Mass loading $\sim 100 \text{ mg/m}^3$	In-stack $\sim 10\%$ Visible plume opacity $\approx 20-30\%$	Sulfuric acid conc.: $\sim 10 \text{ ppm}$ Bimodal distribution with large particle mode at $4 \mu\text{m}$ and total mass loading 100 mg/m^3 A) Submicron mode @ $0.15 \mu\text{m}$ with $1 \times 10^6 \text{ \#/cm}^3$ B) Submicron mode @ $0.4 \mu\text{m}$ with $5 \times 10^4 \text{ \#/cm}^3$	In-stack opacity $\sim 11\%$ A) Peak Plume opacity $\approx 35\%$ B) Peak plume opacity $\approx 24\%$
2	Coal-fired power plant, ESP outlet S in coal $\sim 5\%$	In-stack $\sim 3-4\%$ Visual plume opacity $\approx 24-29\%$	Sulfuric acid conc.: 10 ppm Bimodal distribution with large particle mode at $6 \mu\text{m}$ and total mass loading 100 mg/m^3 Submicron mode @ $0.15 \mu\text{m}$ with $1 \times 10^6 \text{ \#/cm}^3$	In-stack opacity 5% Peak plume opacity $\approx 30\%$
3	Oil-fired power plant outlet S in oil $\sim 2.4\%$ 590 ppm V in oil Particulate loading 250-390 mg/m^3 Total $\text{SO}_4 \sim 340 \text{ mg/m}^3$	In-stack opacity $\sim 11-22\%$ Visual plume opacity $\sim 40-60\%$	Bimodal distribution with large particle mode @ $6 \mu\text{m}$ Mass loading 340 mg/m^3 Submicron mode @ $0.15 \mu\text{m}$ with $1 \times 10^6 \text{ \#/cm}^3$ A) $10 \text{ ppm H}_2\text{SO}_4$ B) $20 \text{ ppm H}_2\text{SO}_4$	In-stack opacity $\approx 17\%$ Peak plume opacity A) $\approx 39\%$ B) $\approx 57\%$

Further analysis of the variation of the model parameters are summarized in Table 5 for fifteen case studies.

TABLE 5

Case #	H ₂ SO ₄ conc. (ppm)	H ₂ SO ₄ particle size		Population		Opacity (%)	
		d ₁ (μm)	d ₂ (μm)	N ₁ (#/cm ³)	N ₂ (#/cm ³)	Initial	Peak
1	4	0.15	2.0	1x10 ⁶	6x10 ³	11.5	20
2	10	0.15	2.0	1x10 ⁶	6x10 ³	11.5	35
3	20	0.15	2.0	1x10 ⁶	6x10 ³	11.5	52
4	40	0.15	2.0	1x10 ⁶	6x10 ³	11.5	70
5	4	----	2.0	-----	6x10 ³	11	13
6	10	----	2.0	-----	6x10 ³	11	25
7	20	----	2.0	-----	6x10 ³	11	45
8	40	----	2.0	-----	6x10 ³	11	69
9	40	0.15	---	1x10 ⁶	-----	1	67.5
10	20	0.15	---	1x10 ⁶	-----	1	48
11	10	0.15	---	1x10 ⁶	-----	1	29
12	10	0.10	---	3x10 ⁶	-----	0.5	28
13	10	0.4	---	5x10 ⁴	-----	3.0	20
14	10	0.15	---	1x10 ⁶	-----	1	29
15	10	0.15	---	1x10 ⁵	-----	0.1	20

Case 1 through 4 illustrates the impact of sulfuric acid concentration on plume opacities due to submicron (0.15μ) and large (2.0μ) size particles of sulfuric acid.

Comparison of Case 5 through 8 with case 1 through 4 indicates effect of submicron mode on opacities at low to moderate acid vapor concentration.

Further analysis of Table 5 indicates the effectiveness alone of submicron sulfuric acid particles on increasing opacities.

Finally, Case 14 and 15 illustrate the effect of submicron size sulfuric acid particles at mean concentration (~ 10 ppm) on plume opacity.

As illustrated in Figures 3 and 4, Damle and Ensor document the influence of submicron size particles of condensed sulfuric acid on plume opacities with time.

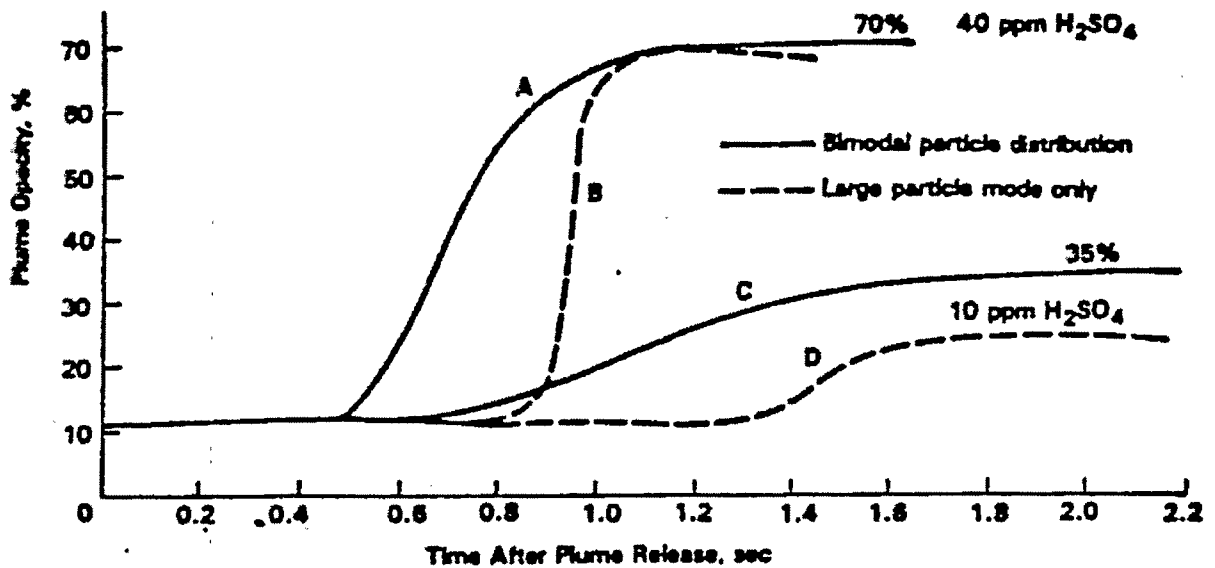


Figure 3 . Effect of Initial Particle Size on Plume Opacity

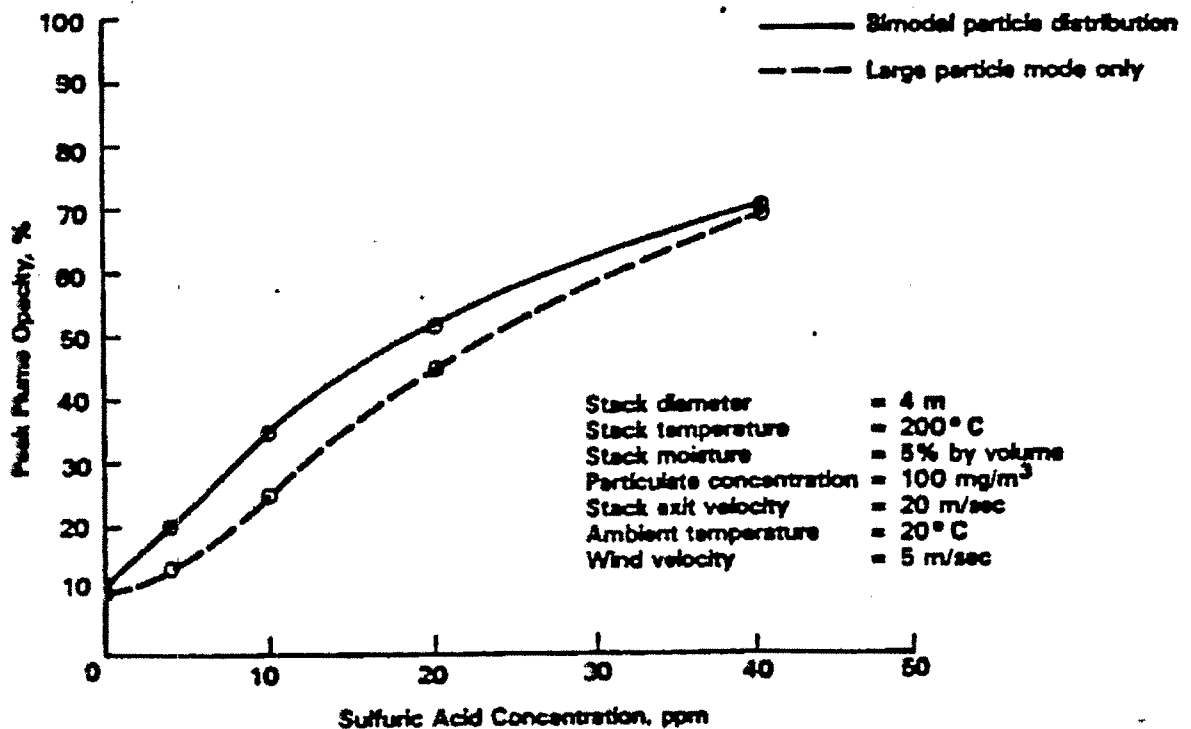


Figure 4. Relationship of Sulfuric Acid Concentration on Plume Opacity

3.0 Summary

In summary, the computer modeling and case studies comparison alone with variation of model parameters (sulfuric acid concentration, particle size, etc.) lead to the following conclusions:

- o The increased plume opacities are due to the presence of submicron sulfuric acid particles;
- o At higher sulfuric acid concentrations (~ 20 ppm), plume opacities are not as dependent on initial particle size, thus suggesting heterogeneous rather than homogeneous mechanism; and
- o Added opacities are due to submicron (0.15μ) sulfuric acid particle mode to an existing large (2.0μ) size sulfuric acid particle mode.



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OCT 9 1991

OFFICE OF
AIR AND RADIATION

MEMORANDUM

SUBJECT: National Guidance - Petition For Alternate Opacity Limit
40 CFR 60.11

FROM: Richard Biondi, Deputy Director *Richard Biondi*
Stationary Source Compliance Division
Office of Air Quality Planning and Standards

TO: Air, Pesticides and Toxics Management Division
Directors
Regions I, IV, and VI

Air and Waste Management Division Director
Region II

Air Management Division Directors
Regions III and IX

Air and Radiation Division Director
Region V

Air and Toxics Division Directors
Regions VII, VIII, and X

The criteria used in the accompanying memorandum represent OAQPS/SSCD's guidance for the review and granting of petitions for alternate opacity limits. Regions should use the criteria found in the accompanying memorandum in making similar determinations.

If you have any questions, please call Chris Oh on FTS
398-8732

Attachment

cc: John Seitz
Lydia Wegman
Bruce Jordan
Regional Compliance Branch Chiefs I-X



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OCT 9 1991

OFFICE OF
AIR AND RADIATION

MEMORANDUM

SUBJECT: Indianapolis Power and Light (IPL) Company's Petition
for Alternate Opacity Limit at their Petersburg Units
3 and 4

FROM: John B. Rasnic, Director *John B Rasnic*
Stationary Source Compliance Division
Office of Air Quality Planning and Standards

TO: David A. Kee, Director
Air and Radiation Division - Region V

The Stationary Source Compliance Division (SSCD) has reviewed the Indianapolis Power and Light (IPL) petition for alternate opacity limits for Units 3 and 4 of IPL's Petersburg Generating Station as requested in your memorandum of August 13, 1991. The criteria used to review this petition are given in Attachment A along with our review findings. These criteria represent our position on granting petitions for alternate opacity limitations and should be used as a guideline by Regions making similar determinations. Additional background information from our review is given in Attachment B.

IPL has demonstrated that they can operate their Petersburg Units 3 and 4 in compliance with mass emission rate standards with existing control equipment. However, EPA should not grant IPL an alternative opacity standard based solely on compliance with the mass emission standards. According to EPA policy (June 24, 1991, William G. Rosenberg memorandum) compliance with a mass emission standard does not exempt a source from the visible emission standard established in the SIP for that source.

IPL has also demonstrated that the control equipment can meet the twenty percent opacity standard on an intermittent basis, but they have not satisfactorily demonstrated that the Petersburg Units 3 and 4 and associated air pollution control equipment were operated and maintained in a manner to minimize the opacity emissions during the performance tests or that their affected facility and associated air pollution control equipment were incapable of being adjusted or operated to meet the applicable opacity standard. They failed to demonstrate that they had investigated and exercised all practical means of reducing opacity and that adjustment of the facility's air pollution control

equipment is technically and/or economically infeasible.

EPA should not grant IPL an alternative opacity standard based solely ~~on~~ compliance with the mass emission standards. An alternative opacity standard should only be granted after the requirements of 40 CFR 60.11(e)(6) and the guidance on alternative opacity standards are completely and satisfactorily addressed.

Attachments

Attachment A

Findings

The following is a paragraph by paragraph review of the requirements given to IPL by Region V in the Guidance for Alternative Opacity Limitations (March, 1982) and 40 CFR 60.11(e). SSCD's findings are from information submitted by IPL during testing for an alternate opacity standard.

Guidance Requirement 1

The source must conduct concurrent Reference Method 5 stack testing and Reference Method 9 visible emission readings (and utilize its continuous emission monitor). Particle size testing should also be conducted. The control device(s) shall be in good operating condition and operated in the normal manner.

EPA Finding

Reference Method 5 and 17 stack testing and Reference Method 9 visible emissions readings were conducted at IPL's Units 3 and 4 respectively.

Utilization of continuous emission monitoring for opacity at Unit 3 was not found in IPL's petition.

Particulate emissions at both units were below emission limitations found in 40 CFR 60.40 for Subpart D sources.

Particle size testing was conducted, as required, at both units.

IPL submitted boiler data, ESP data, and scrubber data for both units.

Guidance Requirement 2

The stack tests must be conducted under conditions acceptable to U.S. EPA and the State agency, and witnessed by these parties.

EPA Finding

Testing did not appear to be an issue of concern with Regional and State agencies.

Guidance Requirement 3

The source must demonstrate that the affected facility and associated air pollution control equipment were operated and maintained in a manner to minimize the opacity of emissions during the stack tests.

EPA Finding

IPL has documented that the ESP and FGDS have met NSPS mass emission limitations. They also documented how they were operating their control equipment during the stack test. However, they did not provide required documentation showing that Units 3 and 4 could not be operated differently or retrofits made to the control equipment that would minimize opacity.

This requirement still remains unanswered.

Guidance Requirement 4

The source must demonstrate that the affected facility and associated air pollution control equipment were incapable of being adjusted or operated to meet the applicable opacity standard. This normally entails a detailed statement or report declaring that the source has investigated and exercised all practical means of reducing opacity and finds retrofit of the facility technically and/or economically infeasible.

EPA Finding

The only documentation that the affected facility and associated air pollution control equipment were incapable of being adjusted or operated to meet the applicable opacity standard was the statement made by Research-Cottrell (RC). RC stated that IPL's opacity problems cannot be solved with corrective maintenance. A detailed engineering report documenting RC's statement could not be found in IPL's petition to support this claim. Nor could any evidence be found showing that IPL had investigated and exercised all practical means of reducing opacity and finds retrofit of the facility technically and or economically infeasible.

This requirement has not been satisfactorily addressed.

Guidance Requirement 5

The source must submit relevant information on the process operating conditions and the control device's operating conditions during the tests.

EPA Finding

Process and control equipment operating data for Units 3 and 4 were submitted as required.

Guidance Requirement 6

If there is an opacity monitor, the source must include certification and or audit reports.

EPA Finding

The opacity monitor certification for Unit 3 was not found in the information submitted for review. The opacity monitor certification for Unit 4 was submitted and found to be operating properly.

This requirement has not been satisfactorily addressed for Unit 3's opacity monitor.

Guidance Requirement 7

The source must explain why it cannot meet the present opacity limit although it is in compliance with the applicable mass rule.

EPA Finding

IPL's explanation of why it could not meet the present opacity limit, although it was in compliance with the applicable mass rule, could not be found in their petition for Unit 3 or 4.

This requirement has not been satisfactorily answered.

Guidance Requirement 8

The alternative opacity limit shall be set at a value that has been demonstrated during (and not extrapolated from) testing. The particulate test results shall show clear demonstration of compliance with the applicable particulate emission limitation (i.e., at least 10% below the limit). It should be clearly demonstrated that during such testing the source was operated to the maximum extent practicable to reduce the opacity of emissions (e.g., for an electrostatic precipitator, all sections were in service and performing well; for a baghouse, no leaks were detectable; for a scrubber, the maximum pressure drop and best water quality were maintained; and, for a mist eliminator, there is uniform flow with no sections plugged).

EPA Finding

Opacities at Unit 4 were read from 8 to 60 percent during testing. IPL has requested that both Unit 3 and 4 be granted a 61 percent opacity limitation. This limit was based upon observations conducted at Unit 4 only. Unit 3's opacity observations and operating conditions experienced during testing were not considered for this unit individually.

This requirement has not been satisfactorily addressed.

Guidance Requirement 9

For multiple units which are normally operated together and whose emissions vent through a single stack, simultaneous particulate testing of each unit must be conducted. In such cases, any new alternative opacity limit must reflect the opacity level at the common stack exit, and not individual in-duct opacity levels.

EPA Finding

This requirement is not applicable to IPL's Petersburg Units 3 and 4. These units do not share a common stack exit.

Review of 40 CFR 60.11 Compliance and Maintenance requirements:

"(e)(6) Upon receipt from an owner or operator of the written reports of the results of the performance tests required by subsection 60.8, the opacity observation results and observer certification required by subsection 60.11(e)(1), and the COMS results, if applicable, the Administrator will make a finding concerning compliance with opacity and other applicable standards. If COMS data results are used to comply with an opacity standard, only those results are required to be submitted along with the performance test results required by subsection 60.8. If the Administrator finds that an affected facility is in compliance with all applicable standards for which performance tests are conducted in accordance with subsection 60.8 of this part but, during the time such performance tests are being conducted, fails to meet any applicable opacity standard, he shall notify the owner or operator and advise him that he may petition the Administrator within 10 days of receipt of notification to make appropriate adjustment to the opacity standard for the affected facility.

(e)(7) The Administrator will grant such a petition upon a demonstration by the owner or operator that the affected facility and associated air pollution control equipment was operated and maintained in a manner to minimize the opacity of emissions during the performance tests; that the performance tests were performed under the conditions established by the Administrator; and that the affected facility and associated air pollution control equipment were incapable of being adjusted or operated to meet the applicable opacity standard."

Comments on 40 CFR 60.11 Compliance and Maintenance requirements relative to IPL:

1) Evidence of an in-depth engineering study of the air pollution devices located on Petersburg Units 3 and 4 to minimize the opacity of emissions during the performance tests as required

was not found in IPL's petition for an alternate opacity report. Nor could documentation of IPL's investigation into the causal effect of high opacity at Units 3 and 4 be found. IPL has not demonstrated that they are operating Units 3 and 4's associated air pollution control equipment in a manner to minimize the opacity of emissions during the performance tests.

- 2) IPL has documented that their performance tests were conducted under conditions established by the Administrator.
- 3) IPL has not demonstrated that Units 3 and 4's associated air pollution control equipment were incapable of being adjusted or operated to meet the applicable opacity standard. EPA should not accept Research-Cottrell's (IPL's FGDS vendor) testimony that the FGDS control equipment is incapable of being adjusted or operated to meet the applicable opacity standard without a detailed statement or report to document this claim.

Additional findings are given in Attachment B

Conclusions and Recommendations:

- 1) The IPL Petersburg Units 3 and 4 were in compliance with mass emission rates at the time of testing.
- 2) IPL's stack test of Petersburg Units 3 and 4 is not prima facia evidence that these units cannot be operated in a manner to reduce emissions of opacity.
- 3) IPL's petition for an alternate opacity standard at Petersburg Units 3 and 4 is incomplete.
- 4) An in-depth engineering study of IPL's control equipment should be conducted by a competent engineering firm selected by both IPL and EPA.
- 5) EPA should not grant IPL an alternative opacity standard based solely on compliance with the mass emission standards. An alternative opacity standard should only be granted after the requirements of 40 CFR 60.11(e)(6) and the guidance on alternative opacity standards are completely and satisfactorily addressed.

Attachment B

Additional Background Information:

- Region V Air Compliance Branch comment. The proposed alternate opacity limit is based upon performance testing on unit 4 only, conducted in July, 1986. Testing conducted on unit 3 in August, 1988, exhibited a peak observed opacity of 44 percent. Clearly, an alternate opacity limitation of 61 percent cannot be approved for unit 3. The Branch recommends disapproval of the proposed opacity standard for unit 3.
- Region V Air Compliance Branch comment. The U.S. EPA has no assurance that the ambient air quality standard for PM₁₀ would not be jeopardized if it were to grant the alternative limit to either generating unit. Neither IPL nor the State of Indiana has submitted monitoring data or modeling to support a revised limitation.
- IPL statement - "IPL has complied with all requirements of 40 CFR 60, Subpart D, in the design, construction, initial performance, and continued operation of Unit 4. As discussed under other items of the U.S. EPA guidance, the unit and its associated air pollution control equipment were operating at maximum and optimum levels. IPL has demonstrated that particulate emissions were significantly less than what NSPS sources such as Unit 4 were allowed to emit. Any opacity emission observed in excess of the compliance level of 20 percent is a consequence of the BACT Unit 4's total compliance with the NSPS regulation."
- Jim Cheny with the Army Corp of Engineers informed EPA that there are several "fixes" that can be made to reduce detached plume opacity. One might be as simple as reducing the stack gas temperature. Another is ammonia injection in the inlet of the ESP.
- The following comments were made by Andy Long and Howard Vickers with Bonanza Power Plant. They explained what might cause a gray and brown plume color from an electric utility. Mr. Long is the resident expert on FGDS at Bonanza Power Plant and Mr. Vickers is the Plant Environmental Manager. EPA was informed that:
 - 1) The gray and brown colors were indicators that there were problems with the FGDS demister;
 - 2) Wet lime scrubbers are effective in the reduction of opacity;
 - 3) An increase in opacity from the FGDS demister after a low opacity from the ESP is not representative of normal FGDS demister operation;

- 4) Problems in the FGDS demister may possibly be related to chemistry, air flow, channeling, or overloading of the scrubber; and
- 5) The FGDS demister may be generating an opacity through it's operational process, i.e., fiberglass.

- IPL's Petersburg Unit 4 is equipped with an electrostatic precipitator (ESP) manufactured by Environmental Elements Corporation with a design efficiency of 99.5 percent. It is also equipped with a flue gas desulfurization system (FGDS) manufactured by RC with a design efficiency of 85.7 percent when treating 100 percent of the flue gas. Under normal operating conditions treating 90 percent of the flue gas, the FGDS design efficiency increases to 95 percent.

- IPL contacted their air pollution control equipment vendors concerning the possibility that adjustments and or modifications could be made to the ESP or FGDS which would further improve opacity emissions. IPL concluded that the ESP was controlling particulate emissions to the maximum extent possible because simultaneous particulate samples and monitored opacity values immediately after the ESP indicate such low emissions pass through the ESP. The FGDS vendor, Research-Cottrell (RC), responding to IPL's inquiry, stated the following:

1. Particulate emissions at the FGDS absorber tower outlet are typically 50 percent less than those emissions at the tower inlet. This relationship was confirmed during contractual tests performed at Petersburg Unit 4. RC is not aware of any modifications that could be made to the FGDS that could improve this performance.

2. Water droplet emissions from the FGDS absorber towers are typical; in the range of 0 to 1 gallon per hour as confirmed at Petersburg Unit 4. RC is not aware of any modifications that could improve this performance.

3. Testing at other RC installations with similar gas treatment fractions, i.e., 70 to 100 percent of the ESP exit gases scrubbed in the FGDS, has shown an opacity reduction of 5 to 10 percent from the ESP discharge opacity. RC is not aware of any modifications that could be made to the FGDS that could improve this performance.

- SO₂, O₂, and opacity monitor certifications were reviewed for monitors installed on Unit 4. Relative Accuracy Tests Audit (RATA) monitors for SO₂ and O₂ installed on Unit 4, appeared to be in order. A RATA for NO_x was not conducted at Unit 4. Unit 3 opacity monitor certification was not found in IPL's petition for an alternative opacity standard as required.

- The procedure used to determine the calibration drift (CD) of IPL's SO₂ and O₂ gas monitors are the procedures to be used to determine CD for opacity monitors. EPA should not accept this procedure and follow up on this to ensure that the monitor is properly calibrated.
- Unit 3 - NOx emissions were reported at 0.55 lb/MBTU. NOx monitoring requirements should not be relaxed for this unit.
- Unit 4 - NOx emissions were reported at 0.331 lb/MBTU. This is below seventy percent (70%) of the national emission limit and IPL has exercised it's option not to monitor for NOx emissions. A QA audit of NOx laboratory analysis could not be found in the report.
- Units 3 & 4 - SO₂ emission testing conducted on August 2, 1988 and April 16, 1986 was reviewed and determined to have been conducted properly. A QA audit of SO₂ laboratory analysis could not be found in the reports for Unit 4.
- Unit 4 - Particulate emission test runs appear to have been conducted in accordance with RM 17. A leak rate was identified during the second run of testing conducted on July 24, and EPA assumes that these runs were scrubbed. Testing conducted on July 25 was found to be conducted in an acceptable manner.
- A reduction in particulate was shown to have occurred across the absorber in Unit 4's test report summary. EPA was not able to make this determination from information submitted for Unit 3.
- IPL's petition for an alternative opacity standard was assembled in a random fashion making the review difficult. Dates did not correlate between the weight sheets and stack test field sheets. Some stack test field sheets did not have the filter number. An assumption had to be made by EPA that the weight sheet reflected the correct filter for those stack test runs missing this information.
- Two filter weighings were conducted, the first on July 29, 1986 and the second on August 18, 1986. Weights recorded on July 29 showed that Petersburg unit 4 had exceeded it's emission limitation with an emission rate of 0.1148 lb/MBTU. The August 18 weighing showed that unit 4 had passed the stack test with an emission rate of 0.0165 lb/MBTU.
- Filter No. 21480 weighed 0.0082 on July 29, 1986. The same filter increased in weight to 0.0095 on August 18 and all the other filter weights went down. No explanation was given for the necessity for the two weighings other than this statement "Reweighed with oven drying for 3 hr. @ 220'." The contractor did not indicate if temperatures were taken in 'F or 'C.

- No units of measurement were given in the report for the filter weight or for the volume of liquid collected.
- Both the ~~State~~ State and Regional representatives were present at the test. Dan Hancock with the Indiana's Department of Environmental Management and Bill DiHu were present during testing. Units 3 and 4 were at full generator load during all tests.



McNeal

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET, N.E.
ATLANTA, GEORGIA 30365

4APT-AEB

OCT 17 1995

MEMORANDUM

SUBJECT: Request to Relocate Opacity Monitors at the Louisville Gas and Electric (LG&E) Mill Creek Station, Louisville, Kentucky

FROM: *Winston A. Smith* Winston A. Smith, Director
Air, Pesticides and Toxics Management Division

TO: John Rasnic, Director
Manufacturing, Energy and Transportation Division
Office of Enforcement and Compliance Assurance (2223A)

The purpose of this memorandum is to request comments on the response that Region 4 has drafted in order to answer questions raised in the attached letter from the Air Pollution Control District of Jefferson County (Kentucky). The questions from Jefferson County involve an LG&E request for permission to move opacity monitors from the scrubber stacks on four boilers to a location between the electrostatic precipitators (ESPs) and the scrubbers on each boiler. The stated reason for the proposed relocation is the high opacity in the scrubber stacks, and LG&E attributes this high opacity to the presence of SO₂ in the flue gas.

After reviewing the request from Jefferson County, Region 4 believes that relocating the opacity monitors on Mill Creek Units 1 - 4 would not be appropriate. The basis for this conclusion is that since Mill Creek Units 1 - 4 employ flue gas reheat, opacity monitor interference due to water droplets is not a concern on these units. Therefore, the opacity currently measured in the scrubber stacks on Units 1 - 4 should be representative of that which would be reported by a certified visible emissions reader collecting opacity data at the scrubber outlet. Since there is no assurance that the opacity between the ESPs and scrubbers at Mill Creek Station has any relationship to opacity at the scrubber outlet, the scrubber outlet is clearly the best opacity monitoring location for Mill Creek Units 1 - 4.

Attached is a draft of a letter that provides Jefferson County with the determination above and answers related questions raised by the local agency. Region 4 would appreciate your office reviewing the attached letter and providing us with comments at your earliest possible convenience. Region 4 would also appreciate information regarding whether other regional offices have submitted requests for guidance on similar issues,

and if so, how these questions have been answered. Such information would be helpful because Jefferson County wants to ensure that LG&E is treated the same as other utilities that experience opacity problems due to SO_2 .

If you have any questions or need additional information, please contact Mr. David McNeal of my staff at 404/347-3555, extension 4158.

Attachments



JEFFERSON COUNTY, KENTUCKY
DEPARTMENT OF PLANNING AND ENVIRONMENTAL MANAGEMENT
AIR POLLUTION CONTROL DISTRICT

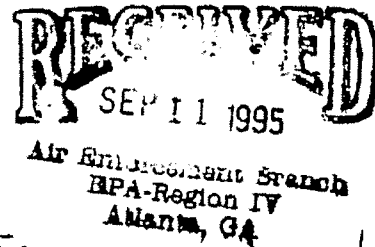
DAVID L. ARMSTRONG
County Judge/Executive

September 5, 1995

ADRIAN P. FREUND
Department Director

BILLY J. SEXTON, PE
District Director

Mr. Brian Beals
U. S. Environmental Protection Agency
Region IV
345 Courtland Avenue, NE
Atlanta, GA 30365



Re: Louisville Gas and Electric Company Opacity Monitor Relocation

Dear Mr. Beals:

Louisville Gas and Electric Company requested to relocate the opacity monitors at the Mill Creek Station. Units #1 and #2 are subject to "existing indirect heat exchanger" regulations. Units #3 and #4 are subject to NSPS Subpart D Regulations. The opacity monitors are located in the stack following the electrostatic precipitators and the wet scrubbers. Due to high opacity values in the stack, the company requested to relocate the opacity monitors after the electrostatic precipitators but prior to the wet scrubbers. It has been assumed that liquid water droplets and SO₃ mist have been causing these high opacity values to occur. The District requested that the company submit a demonstration that water droplets were causing an interference problem with the monitors. The company researched the matter and determined that the flue gas moisture content is below the saturation point. There might be some water droplets in the stack due to demister carry-over or demister washing but overall the company was unsuccessful in demonstrating that water droplets are causing an interference problem. This leads to the conclusion that SO₃ mist is probably causing the high opacity values. The company has experimented with injecting ammonia to reduce SO₃ emissions. Due to the substantial reduction in opacity values during the experimental period, the company agrees that SO₃ is probably the major cause of the high opacity values.

The company does not think that ammonia injection will be a feasible method to reduce SO₃ emissions. Following is a quote from the reactive particle emissions study performed for the plant in 1991:

"Full-scale tests of ammonia injection on Mill Creek Unit 3 demonstrated very high acid removal efficiencies with acceptable ESP performance. Ammonia injection will reduce the sulfuric acid dewpoint below 220°F and therefore prevent acid condensation in nearly all areas of ductwork upstream of the scrubbers with no increase in air heater outlet

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temperature required. This should eliminate the formation of flyash/sulfuric acid agglomerates and eliminate ductwork corrosion.

Two significant technical disadvantages were identified during the ammonia injection tests:

- Ammonia injection resulted in the release of ammonia vapor in the Sludge Processing Plant (SPP) when ammoniated flyash from Unit 3 was blended with scrubber sludge and lime before placement in the landfill. Ammonia vapor concentrations as high as 23 ppm were measured inside the SPP enclosure and outside near the stacked flyash/sludge material.
- Ammonia injection produced additional large particles at the ESP outlets. These particles were probably agglomerates of flyash and the ammonium sulfate/bisulfate reaction products. While they are probably not as corrosive as the sulfuric acid agglomerates, they could still produce a noticeable deposit on the surrounding area if the boilers were operated without the scrubbers on line."

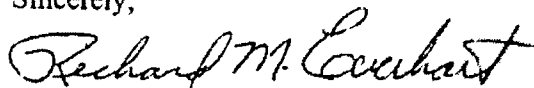
The large particles mentioned above have a dark color and could be the source of nuisance problems for the citizens in the surrounding neighborhood anytime the scrubbers go out of service. The ammonia could also cause an odor nuisance for the neighbors.

The District wants to treat LG&E the same way other power plants throughout the country are treated and would like guidance on the following items:

- Should the opacity monitors continue to be located in the stack? Should the SO₂ emissions be included in the opacity monitor values?
- Is any additional testing for water droplet interference recommended?
- If it is decided that the opacity monitors should be relocated, additional guidance will be needed on how to continue using the monitors for compliance purposes.
- What procedures should be followed if the company thinks it needs to petition for a higher opacity standard as specified in 40 CFR Part 60, Section 60.11, Paragraphs e.6, e.7, and e.8?

Please let us know if you need any additional information.

Sincerely,



Richard M. Everhart, QEP

Engineering/Enforcement Manager

Enclosure

02:S:hh

cc: R. S. Straight, LG&E, C. Bryant, J. McCarthy, D. Spillman